REMARKS

As a preliminary matter, Applicants wish to thank the Examiner for the notice that Claim 16 would be allowed if rewritten in independent form. Claims 1-20 are pending.

Claims 1-15 and 17-20 stand rejected under 35 U.S.C. § 103(a) as being anticipated by U.S. Patent No. 5,850,323 to Engstrom et al. (Engstrom).

Engstrom

Engstrom teaches the well known technique of screen flipping:

> In computer generated graphics, a technique known as "screen flipping" is commonly used to provide smooth animation. In this technique, **two memory buffers** in video memory are used to generate an image. While **a first image is being rendered to a first buffer**, the display hardware scans out a complete image from a second buffer. To update the display with a new image, the display hardware then performs a buffer swap. The display image that was just under construction is then transferred to the display screen, and a new image is constructed in the buffer that held the previous display image.

(Engstrom, Col. 1, lines 40-50) (emphasis added). Engstrom, therefore, is limited to using two memory buffers for rendering to a first buffer and scanning out of a second buffer.

Engstrom seeks to resolve the problem of flipping only a portion of a display image, rather than the entire display screen. (Engstrom, ¶1, lines 61-64). Engstrom provides a method for flipping images in a window using overlays. (Engstrom, ¶1, lines 21-64). The support for flipping images in a window is implemented in a software interface for a display device in a computer. Id. In this context, it enables application programs to flip in a window without disturbing other parts of the display image. Id.

> When an application makes a call to modify a surface, for example, the display device interface makes sure that it is safe to modify the underlying surface memory. (¶19, 1 6-9.). However, since <u>a hardware page flip is not involved</u>, the flip control does not have to ensure that the display controller has completed a previous page flip request. (¶19, 43-45).

> Unfortunately, **most display hardware does not specify explicitly** when it is safe to draw to a back buffer, or in other words, when it has completed reading these addresses. As such, the display device interface (in conjunction with the HAL or display driver on the host PC) has to determine when it is safe to: 1) modify a back buffer in response to a flip, bit, or lock request; and 2) in the case of a flip request, alter the display address. (¶ 20, lines 37-40). (emphasis added).

> Another check, shown in dashed lines (454) in FIG. 12A, is to check whether the hardware explicitly indicates that it has completed a **page** flip. (¶ 21, lines 49-51). (emphasis added).

Accordingly, Engstrom teaches that display hardware does not specify explicitly when it is safe to draw to the back buffer. To the extent that Engstrom describes a hardware mechanism for managing access to the frame buffer, Engstrom is limited to hardware that indicates if a page flip has occurred, not whether the raster has accessed a particular memory location.

> Next, the driver compares the current time with the sum of the time of the last flip request and the refresh time (414). If an entire refresh period has not elapsed since the last flip request, it is not safe to change the state of the display controller. As such, the driver returns a "WasStillDrawing" error (416). (¶ 20, lines 58-63).

> If a refresh period has elapsed since the last flip request, the driver records the current time of the flip request and proceeds to update the hardware register (418, and 420). Specifically, the driver writes the address of the surface memory of the new front buffer to the display address. At this point, the driver has successfully completed the flip and it returns. (¶ 20, lines 64-67, ¶21, lines 1-3).

> Specifically, the driver checks the current time and determines whether a refresh period has elapsed since the last flip. If not, the error is returned. (¶21, lines 10-11).

> In addition, or as an alternative to using the time of the last flip request, the driver can evaluate whether it is safe to complete a flip by determining if the display controller has moved outside the VB period since the last flip request. If the display controller is not in the VB period, but has entered it since the previous flip was initiated, it is safe <u>to assume</u> the flip has completed and the display address has been changed. (¶21, lines 14-24).

> Another optimization in the flip control is to read the scan line register, analyze the scan line position relative to the position **when the last flip occurred**. If the scan line is less than the scan line at the time the last flip occurred, then it **is safe to assume** the previous flip operation has completed and the display address has been changed.

(Engstrom, Col. 21, lines 28–32) (emphasis added). Accordingly, Engstrom is limited to waiting until a flip has completed, rather than when the raster has accessed a particular memory location.

Firstly, Engstrom teaches scanning without regard to the memory location as scanning is performed because an entire screen is scanned without interruption. Engstrom is limited to "analyze the scan-line position relative to the position **when the last flip occurred**" as opposed to "storage of the image at the first memory location **when the second memory location indicates the raster has accessed data at the first memory location.**" Secondly, in contrast to the claims, Engstrom merely assumes that a scan line may be scanned if the scan line is less than the scan line at the time the last flip occurred. Thirdly, storage of the image as recited in the claims occurs at a specific condition, namely, "when the second memory location indicates the raster has not accessed data at the first memory location."

The teachings of Engstrom appear to be similar to the prior art system described in Applicants' Background of the Invention section. Prior art systems assume the primitive will not cause tearing, because *it is necessary to wait until the display engine indicates all locations of the frame buffer needed to store the primitive image have been rastered.* (Specification, page 2, lines 24-37). Tearing occurs when the rendering engine writes new image information into the frame buffer over frame buffer locations that contain data yet to be displayed from the previous image. (Specification, page 2, lines 2-6). In other words, during a single screen refresh cycle, portions of data from two frames of data will be displayed. Id. The tearing produces non-contiguous images that are detectable by users. Id. As a result, Engstrom teaches the prior art

solution discussed in the prior art section of the specification, namely waiting until the display engine indicates all locations of the frame buffer needed to store the primitive image have been rastered. Since the claimed invention stores the image when the raster has accessed data in the first memory location, the claimed invention can write to the later much earlier than the system in Engstrom.

As an example of the advantages of the claimed invention as described in the specification, where a large triangle is to be issued for rendering, and only a small portion of the triangle is below the line currently being rastered, the prior art (such as Engstrom) operation can result in the display engine indicating the frame buffer is not ready. Therefore, a dispatch of the operation is stalled in the prior art system even though the rendering engine could be doing useful work on most of the triangle. (See, for example, Specification, page 2, lines 22-30, page 3, line 1).

Independent claim 1

Independent claim 1 recites:

> 1. A method for providing image data:
>
> receiving a rendering command;
>
> rendering an image based upon the rendering command, wherein the image is to be stored at a first memory location of a first frame buffer;
>
> determining a second memory location representative of a raster location;
>
> enabling, by a write behind controller in a video graphics adapter, storage of the image at the first memory location *when the second memory location indicates the raster has accessed data at the first memory location*; and
>
> preventing, by the write behind controller, storage of the image at the first memory location when the second memory location

indicates the raster has not accessed data at the first memory location.

The write behind controller receives control information from a display device controller in order to determine a current location available in a frame buffer for receiving information. (Specification, page 4, lines 1-3). As a result, the write behind controller may store the image into the frame buffer, as soon as *when the second memory location indicates the raster has accessed data at the first memory location*, instead of waiting until the buffer is full as required by and the prior art system taught in Engstrom. Therefore, the write behind controller solves the problem of determining the soonest point in time that data can be written into the frame buffer so that the frame buffer and the rendering engine will be used most efficiently. Unlike Engstrom, the claimed invention is a hardware implementation to control whether or not the rendering engine can write into a specific memory location. (Specification, page 5, lines 9-11). This is unlike Engstrom and the prior art, which made the determination at the system level based on worst case scenarios after the entire frame buffer is rastered. (Specification, page 5, lines 11-12). One advantage provided by the claimed invention is that it is possible for a primitive, when received by the rending engine may not be able to be written in its entirety into the frame buffer, to be processed by the rending engine and written into available locations of the frame buffer without the system having to be concerned whether a sent rendering command can be currently displayed after the entire frame buff is rastered. (Specification, page 5, lines 12-17). The claimed invention therefore solves the problem of utilizing the frame buffer and the rendering engine more efficiently than the prior art. (Specification, page 5, lines 18-19).

ENGSTROM DOES NOT DESCRIBE AT LEAST "STORAGE OF THE IMAGE AT THE FIRST MEMORY LOCATION WHEN THE SECOND MEMORY LOCATION INDICATES THE RASTER HAS ACCESSED DATA AT THE FIRST MEMORY LOCATION"

Firstly, the Office Action acknowledges that Engstrom does not teach a video graphics adapter. (Office Action, page 4, ¶ 7). The Office Action recites Engstrom col. 6 lines 25-43, col. 22 lines 31-33 and Fig 12 B as teaching "enabling, by a write behind controller, storage of the image at the first memory location when the second memory location indicates the raster has accessed data at the first memory location." However, the cited portions of Engstrom do not

teach the claim element arranged as required by the claim. As previously stated, Engstrom is limited to "analyze the scan line position relative to the position **when the last flip occurred**" as opposed to "storage of the image at the first memory location **when the second memory location indicates the raster has accessed data at the first memory location.**" The cited portions of Engstrom teach that if the scan line is less than the scan line at the time the last flip occurred, then it is safe to assume the previous flip operation is completed. Engstrom therefore is referring to a completely different parameter or condition for writing into the frame buffer than the second memory location for indicating the raster has accessed data at the first memory location. For example, the raster may have accessed data at the first memory location, but a flip may not have occurred because the raster has not finished reading the entire display image in the frame buffer. Because Engstrom requires that the rendering engine must wait for the raster engine to finish reading the entire display buffer and request a flip, the graphics processor is idle and not performing any useful work during this time period. As a result, Engstrom only teaches enabling writing into the frame buffer based on a different condition, namely after a flip has occurred rather than immediately "when the second memory location indicates the raster has accessed data at the first memory location."

Similarly, Engstrom as cited fails to teach "when the second memory location indicates the raster has not accessed data of the first memory location. "Instead, Engstrom teaches, "If an entire refresh period has not elapsed since the last flip request, it is not safe to change the state of the display controller." However, if the raster has accessed data at the first memory location, i.e., a pixel within the display image, but the display is not flipped, or if the refresh period has not elapsed, Engstrom would prevent writing to the frame buffer whereas the claimed invention would allow writing to the frame buffer. Since the first memory location is already rasterized,

Received from < 3126095005 > at 8/29/03 5:43:36 PM [Eastern Daylight Time]

the graphics processor may be performing useful work writing to the frame buffer. However, according to Engstrom, the graphics processor would be idle while it is waiting for a flip or a screen refresh and therefore is waiting rather than performing useful work. Accordingly, Engstrom does not describe storage of the image at the first memory location *when the second memory location indicates the raster has accessed data at the first memory location.*

Secondly, in contrast to the claims, Engstrom assumes that a scan line may be scanned if the scan line is less than the scan line at the time the last flip occurred. Again, Engstrom teaches the prior art as taught in the background section of the specification, namely, determining when to write to the frame buffer based on a worst-case scenario, i.e., last page flip plus refresh time.

Thirdly, storage of the image as recited in the claims occurs at a specific condition, namely, "when the second memory location indicates the raster has not accessed data at the first memory location." Engstrom, however, fails to teach this condition because Engstrom makes an assumption that "it is safe to assume the previous flip operation has completed." Again, the specification states that the frame buffer is utilized more efficiently "[u]nlike the prior art, which made the determination at the system level based on worst case scenarios." (Specification page 5, lines 11–19). Accordingly, Engstrom does not teach ""storage of the image at the first memory location **when the second memory location indicates the raster has accessed data at the first memory location.**" Consequently, Engstrom and the cited references do not teach all the elements of the claims.

Since Engstrom teaches writing to the frame buffer only after a flip operation, Engstrom teaches away from "storage of the image at the first memory location when the second memory location indicates the raster has accessed data at the first memory location." Since Engstrom teaches away from the invention, there is no motivation to modify the invention with another

teaching, and therefore, the Office Action fails to establish a prima facie case of obviousness.[1] Further, such a modification would render Engstrom inoperable[2] because Engstrom does not have the requisite hardware to determine if a specific location in the frame buffer has been rasterized before a flip operation since Engstrom merely assumes that the location has been rasterized only after a flip operation. Finally, modifying Engstrom to write to the frame buffer without waiting to analyze the scan line position relative to the position when the last flip occurred would change the principle of operation of Engstrom.[3] Consequently, the Office Action fails to establish a prima facie case of obviousness.

ENGSTROM TEACHES AWAY FROM AT LEAST "PREVENTING, BY THE WRITE BEHIND CONTROLLER, STORAGE OF THE IMAGE AT THE FIRST MEMORY LOCATION WHEN THE SECOND MEMORY LOCATION INDICATES THE RASTER HAS NOT ACCESSED DATA AT THE FIRST MEMORY LOCATION"

According to the Office Action, Engstrom at Col. 22, lines 12-30 teaches "preventing, by a write behind controller, storage of the image at the first memory location when the second memory location indicates the raster has not accessed data at the first memory location." However, the cited portions of Engstrom do not teach all the claim elements arranged as required by the claim. In contrast to the claim, Engstrom as cited teaches:

> If the display controller is in the VB period at the current flip request, the flip control has to do more checking. First, it sets the bit indicating that the display controller is in the VB period (466) and then performs a check similar to the one shown in FIG. 10. Specifically, it checks whether a refresh period has elapsed since the last flip request (468, 470). To accomplish this, the flip control gets the

---

[1] A prior art reference must be considered in its entirety, i.e. as a whole including portions that would lead away from the claimed invention. (W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) MPEP 2141.02).

[2] The proposed modification cannot render the prior art unsatisfactory for its intended purpose. *In re Gordon*, 733 F.2d 200, 221 USPQ 1125 (Fed. Cir. 1984), MPEP 2143.01.

[3] If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). See MPEP 2143.01.

current time and **compares it with the sum of the last flip request time plus the refresh time**. If a refresh time has elapsed, it is safe to update the display address. If not, the flip control returns the 'WasStillDrawing' error.

(Engstrom Col. 22, lines 8–18. (emphasis added). As previously stated, Engstrom teaches that "the flip control gets the current time and compares it with the sum of the last flip request time plus the refresh time" rather than "when the second memory location indicates the raster has not accessed data at the first memory location" as claimed. Engstrom teaches that the "was still drawing" error be asserted if the refresh time has not elapsed. Instead, the claims recite "preventing...storage... when the second memory location indicates the raster has not accessed data at the first memory location." Engstrom teaches against the claims because Engstrom teaches "If the current position of the scan line is below the previous position, **then the scan line test is inconclusive**…." (Engstrom Col. 22, lines 27–30 (emphasis added). In contrast, the claims teach a conclusive operation, namely "preventing, by the write behind controller, storage of the image at the first memory location *when* the second memory location indicates the raster has not accessed data at the first memory location." If the display engine has read from the first memory location in the frame buffer and if the display has not yet flipped because the display engine is still reading from memory locations after the first memory location but before the end of the display image, then Engstrom would prevent writing to the first memory location where the claims would allow writing to the first memory location. As a result, Engstrom teaches away from "preventing, by the write behind controller, storage of the image at the first memory location when the second memory location indicates the raster has not accessed data at the first memory location." Accordingly, Engstrom, as cited in the Office Action teaches away from the claims and therefore there is no motivation to modify Engstrom to produce the claimed invention. For at least the reasons provided above these claims are not obvious in view of Engstrom. Accordingly, these claims are believed to be in condition for allowance.

As to Claim 2, Applicants respectfully submit that this claim adds additional novel subject matter. Further, because claim 2 depends on claim 1, claim 2 is allowable for at least the reasons claim 1 is allowable.

As for Claims 6 and 7, Col. 7, lines. 17-25 of Engstrom have been cited. Since Claims 6 and 7 depend from Claim 1, Applicants respectfully reassert the relevant remarks made with respect to Claim 1. Further, the back buffer described in this section of Engstrom does not appear to be the frame buffer (the primary surface structure) and as such for at least these reasons these claims are not anticipated.

As to Claims 8 and 9, the Office Action cites Col. 4, lines 59-62 of Engstrom. However, these cited lines of Engstrom merely indicate that a 2D or 3D graphics engine is the display hardware. Applicants respectfully submit that the cited portion does not describe how graphics primitives are provided to the graphics engine when the rendering engine is storing data to a frame buffer wherein the frame buffer is being accessed by a display device controller that is providing a current image. The claim further requires that the display device controller is at a point where it has not yet accessed an address location having data associated with a current image wherein that location is between the first two address locations such that the graphics primitive is provided to the rendering engine at this point. Typically, as previously stated with respect to prior art systems, the graphics primitive would not be submitted to a rendering engine at this point in time. Accordingly, this claim for at least these reasons is also believed to be in condition for allowance. Applicants respectfully submit that Claims 8 and 9 add additional novel subject matter and are allowable as at least depending from an allowable base claim.

Claims 11, 12 and 17-20 stand rejected based on the same rationale for Claim 1. Applicants respectfully reassert at least the relevant remarks made above with respect to Claim 1.

Accordingly, these claims are also believed to be in condition for allowance. Applicants respectfully submit that claims 11, 12 and 17-20 add additional novel subject matter and is allowable as at least depending from an allowable base claim.

Claim 10 stands rejected under 35 U.S.C. § 103(a) based on Engstrom in view of official notice. Claim 10 recites among other things wherein the address locations include display line numbers. Applicants respectfully submit that this claim adds additional novel subject matter and is also allowable at least as depending upon an allowable base claim.

Applicants respectfully submit that the claims are in condition for allowance, and an early Notice of Allowance is earnestly solicited. The Examiner is invited to telephone the below-listed attorney at 312-609-7970 if the Examiner believes that a telephone conference will expedite the prosecution of the application.

Date: August 29, 2003

Respectfully submitted,

By: [signature]
Themi Anagnos
Registration No. 47,388

Vedder, Price, Kaufman & Kammholz, P.C.
222 N. LaSalle Street
Chicago, IL 60601
Phone: (312) 609-7970
Facsimile: (312) 609-5005